Ch3 Atoms

Early History Atomic Theory → dates Back to Ancient Greek philosophers

Democritus → believed matter could be broken down to a basic particle

"atoms" - Greek for indivisible particles

↳ NO Proof. Just Thought

↳ Furthermore Dem. said atoms for various shapes + sizes

↳ Round ones for water

Ones that were fire

Said if they changed positions changed props.

Aristotle → said 4 elements (earth, fire, wind, water)

↳ 4 props → hot, cold, wet, dry

if we Δ'd amounts props change.

Alchemy - middle ages → Lavosier - padre de chimica

↳ Showed that O_2 req. for combustion.

(disproves 4 elem)

Note → As tech. evolved so did our depths of study

Dalton - brilliant → taught school @ 12
published atomic Theory @ 37 (1803)

based on LDC, LCM → realized these laws explained Rxns
CMP

Dalton's Atomic Theory

1. All matter composed of small particles (atoms)
2. atoms of same element same size, mass etc
   " diff " diff " "
3. atoms ~~are~~ cannot be subdivided, created, destroyed
4. atoms combine in small whole # ratios to form compounds. CO, CO_2 ← CMP
5. In rxn, atoms are combined, separated rearranged

Exceptions → Atoms are divisible →
Isotopes

Ch3 HMWK H pg 74 Q2
pg 82 Q2, 4
pg 92 Q2, 3, 6, 7
pg 93 Rev Con 6, 12, 16
pg 94 Prob 1, 5, 6
pg 95 Prob 9(~~a, c, e~~)
10(~~a, c, e~~)

~~AF pg 74 Q2~~
~~pg 82 Q2, 4~~
~~pg 92 Q2, 3, 6, 7~~
~~pg 93 Q2 3~~
~~pg 94 Problem 2(a, c, e)~~
~~3(a, c, e)~~
~~6 (a, c, e)~~
~~7(a, c, e)~~
~~pg 95 App Prob Q1~~

AF Read Ch3
pg 69 Q 2, 3
85 Q 2, 3, 5, 6.
pg 87 Rev Conc 2, 4, 5
Prob 17, 19
pg 88 Q 21, 23

Structure of the Atom

Joseph Thomson 1897 → discovered the e^-

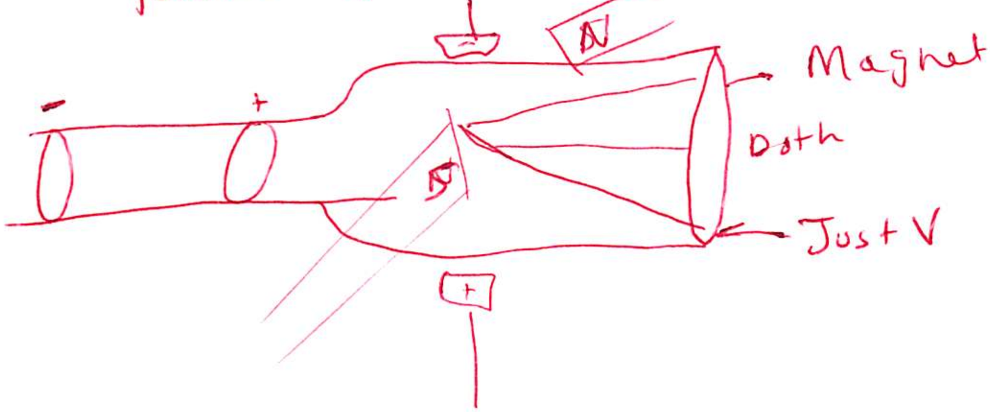
William Crookes tube → New 1st tube Mag deflection thought Neg particle
Thomson proved it

Used Cathode Ray Tubes (TV)

↳ Glass tube w/ gas @ low P

Pass current through - glow different colors

particles from anode to cathode



found magnet → deflect ray
current - deflect ray (to (+))
} said ray was (−)

paddlewheel move (−) → (+)

put paddlewheel in → moves so matter is there matter

Thomson's work said the $\frac{\text{charge}}{\text{mass}}$ ratio is

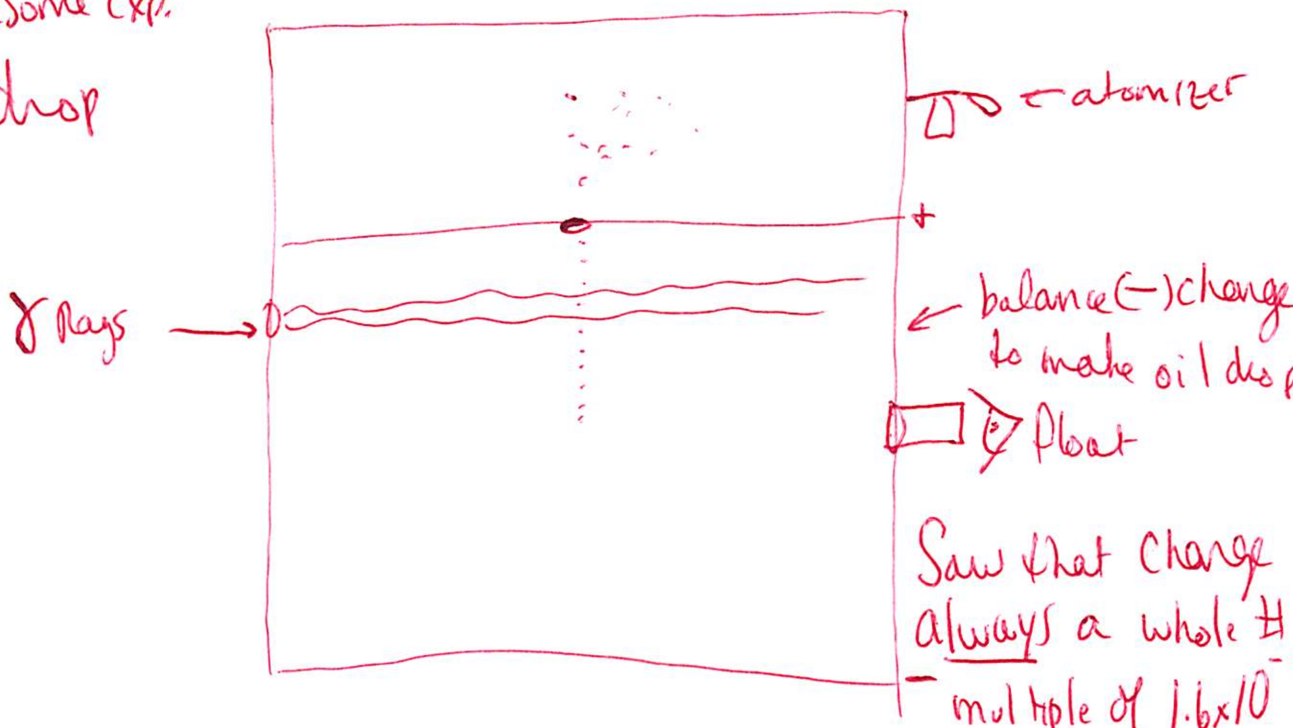
$\frac{1.76 \times 10^8 \text{ Coloumb}}{\text{gram}}$ V. high.

Nobel prize

Millikan → found change + mass of e^- → 1911
Nobel Prize 1923

Awesome Exp.

Oil drop



Saw that change **always** a whole # multiple of 1.6×10^{-19} C

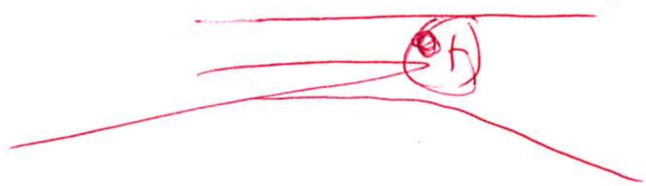
Now ~~she~~ can solve for mass

$$1.6 \times 10^{-19} C / 1.76 \times 10^{8} \frac{C}{g} = 9.01 \times 10^{-28} g$$

Left open Q's
must be something else to be responsible for mass e- small
Something balance change.

Nobel

X-ture of the atom

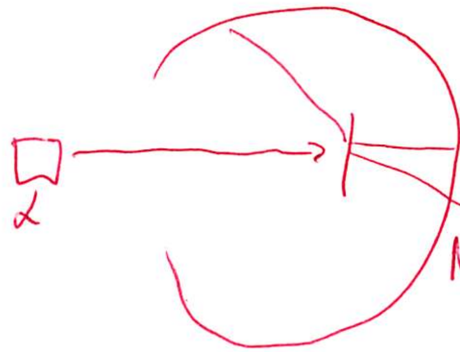


Rutherford (Thomson's student) - Gold foil exp. → 1909
Geiger, Marsden

studied α particles from radiation

saw deflection

Explain Exp.



Anatomy of the nucleus → proton (+) charge = to e^-
mass = 1.673×10^{-24} g
If 8p → Oxygen
] # of protons is identity of element.

atoms are neutral charged so # p = # e^-

held together by nuclear forces

neutrons → 1.675×10^{-24} g → vary in number
↳ Isotopes → different # of neutrons

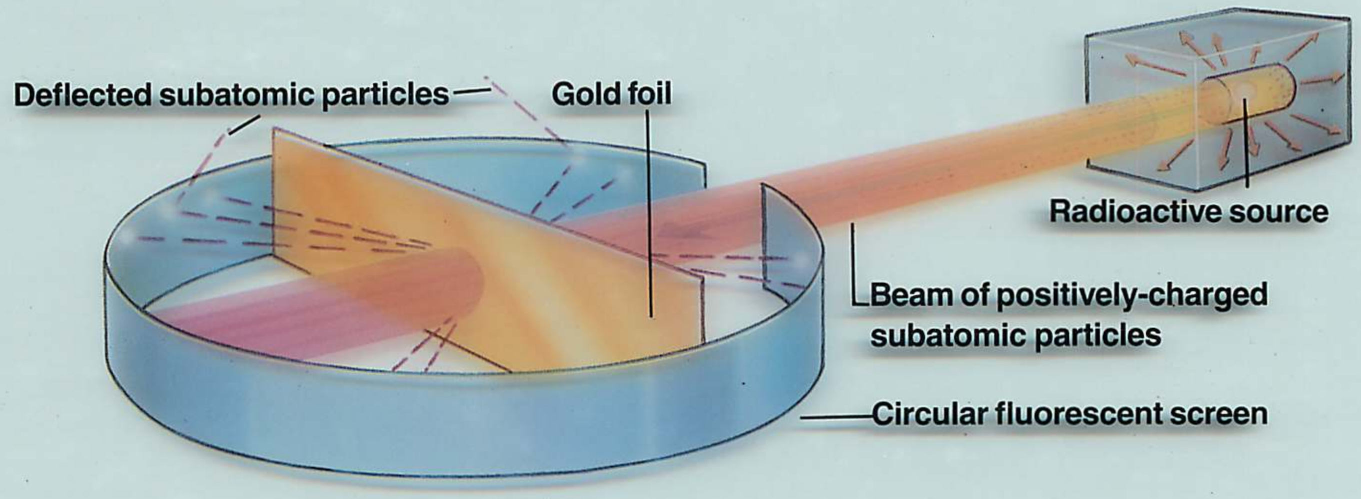
~~Indent~~

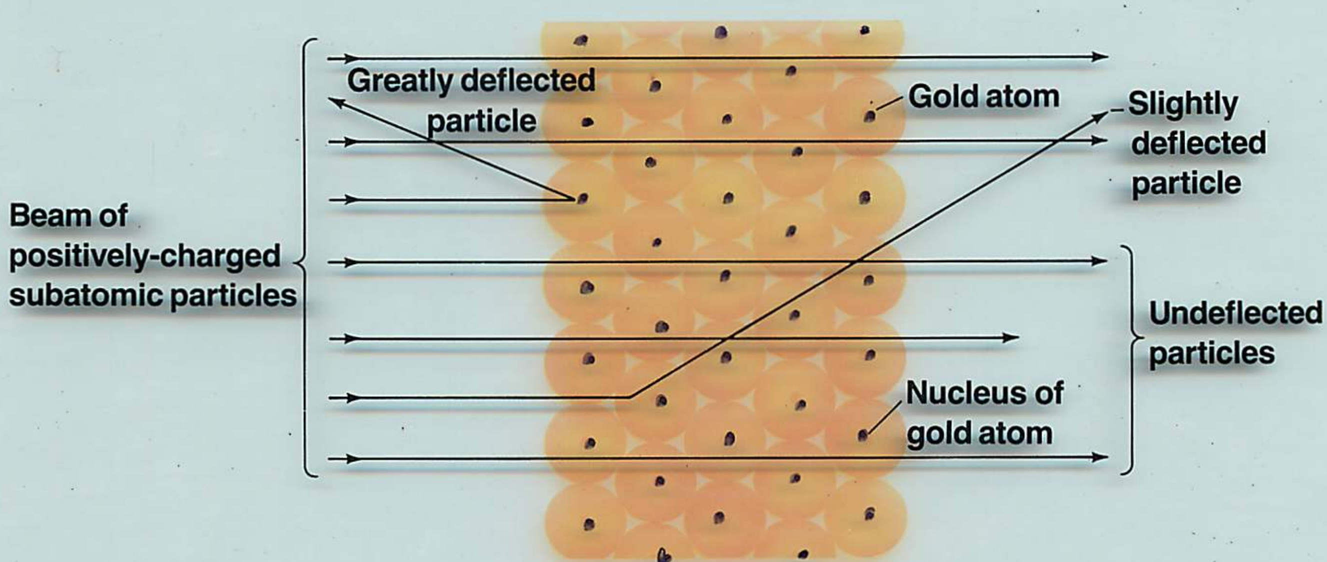
electrons → mass 9.109×10^{-28} g] → mass 1836x less than proton.

Charge 1.6×10^{-19} C

Tritium ^3H
Deuterium ^2H
Protium ^1H

5 RUTHERFORD'S GOLD FOIL EXPERIMENT





atomic # → number of protons

mass # → " " protons + neutrons

to calculate # of n → Atomic Mass - Atomic # = # of n

# of protons → Atomic #

# of electrons → if atom → same # of protons (charge neutral)

if ion → look @ charge differential

<u>Worksheet</u>

Also included → Notations - hyphen-Notation

Symbol Notation

Element Name - Mass #

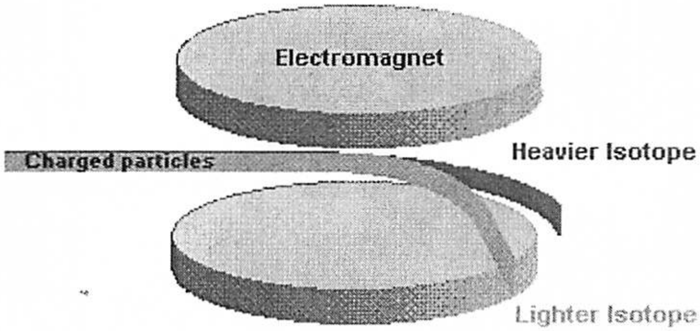
Phosphorous - 31

Phosphorous - 32

Mass # → $^{3}_{1}H$ ← Atom #

You'll also notice that the atomic masses of each element are known *very* accurately. It would be impossible to construct a balance that had moving parts with that kind of accuracy--the vibration of the earth's crust would never allow it to become stable. Today's atomic masses are not calculated using a balance at all. Instead, they are measured using various forms of mass spectroscopy.

A mass spectrometer can provide extremely accurate measurement of the mass of an individual atom. Here's how it works. A moving charged particle (an ion of an atom) will bend if it is placed in a magnetic field. The amount that it bends depends on its charge (+2 charged particles would bend twice as much as +1 charged ones, and negatively charged particles would bend the opposite direction). More importantly, the amount that the particle's path curves depends on its mass.



It is sort of like rolling a steel shot put past a magnet. Because of its heavy mass, the path of the shot put would be very straight, compared to the path for a small ball bearing. In other words, a light particle will bend more in a magnetic field. In a mass spectrometer, atoms are charged by bombarding them with electrons. These charged atoms pass through a strong magnetic field, and their path bends. The lightest atoms bend a lot. The heavier atoms bend very little. Some type of detector is used to measure where the atoms arrive. By measuring the curvature of the path, and comparing it a known atom - our standard being Carbon-12 - very accurate masses can be calculated.

In the original mass spectrograph, a photographic film was the detector. The film would be darkened by the impacting charged particles. The more particles that arrived, the darker the film would become. Measuring the amount of this exposure allowed scientists to calculate the percentage abundance of each isotope. In a modern mass spectrometer electronic devices are used to measure the number of ions which arrive, but the principle remains the same - heavy atoms and light atoms can be separated very precisely on the basis of their mass.

Once the precise atomic masses of each isotope, and their relative abundances are known, the average mass of the isotope as found in nature can be calculated. In fact, the atomic masses are known very precisely, as shown in the above tables, but the abundances are much less accurately known. This is partly because the abundance of isotopes can vary from one location on earth to another. Certain naturally occurring process can concentrate the abundance of one type of isotope in one location as compared to another. Lead's isotopic abundance is one of the least reproducible because various isotopes are the final products of the radioactive decay of a number of heavy elements. To find the average mass of the mixture of isotopes found in nature the following procedure is used: multiply the abundance of each naturally occurring isotope of element by its precise atomic mass and then sum them all. Here are the results for a couple of elements.

Relative Atomic

one atom of oxygen = 2.65×10^{-23} g

for convenience we use relative mass

Relative mass 1 atom chosen as a standard.

Carbon → 12 u → 1u = $\frac{1}{12}$ mass of ^{12}C atom

amu 1u = 1.66×10^{-24} g → Oxygen: 16u

Avg Atomic Mass

Weighted atomic mass → percent is factored in

(mass)(%) + mass(%) ...
↖ as decimal

do example

Mole concept → compare ^{12}C, ^{4}He atoms → 3x as many He atoms to balance
↑ 12amu ↑ 4amu

Mole → # of atoms in 12 g ^{12}C → 6.022×10^{23} atoms/mol

Av # → 6.022×10^{23} particles/mole

Molar Mass – # grams in 1 mol
↳ equal to atomic mass in g.